Food Insufficiency Exists in the United States: Results from the Third National Health and Nutrition Examination Survey (NHANES III)

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ABSTRACT

Objectives. The purpose of this study was to estimate the prevalence of food insufficiency in the United States and to examine sociodemographic characteristics related to food insufficiency.

Methods. Data were analyzed from the third National Health and Nutrition Examination Survey, a cross-sectional representative sample of the civilian noninstitutionalized population living in households. Individuals were classified as "food insufficient" if a family respondent reported that the family sometimes or often did not get enough food to eat.

Results. From 1988 through 1994, the overall prevalence of food insufficiency was 4.1% and was primarily related to poverty status. In the low-income population, food insufficiency was positively associated with being Mexican American, being under the age of 60, having a family head who had not completed high school, participating in the Food Stamp Program, and not having health insurance. It was not related to family type or employment status of the family head. Over half of food-insufficient individuals lived in employed families.

Conclusions. Food insufficiency is not limited to very low-income persons, specific racial/ethnic groups, family types, or the unemployed. Understanding food insufficiency is critical to formulating nutrition programs and policies. (*Am J Public Health.* 1998;88:419–426)

Introduction

Reports documenting that some Americans do not get enough food to eat have existed for decades,[1–3] and recent studies conducted by advocacy groups suggest that food insufficiency is a persistent problem in the United States.[4–6] This is not surprising; in 1994, approximately 15% of the population, or 38 million Americans, lived at or below the poverty line, with incomes below $15 150 for a family of four.[7] An additional 14 million, totaling almost a fifth of the US population, had incomes at or below 130% of the poverty line, the income eligibility criterion for federal assistance programs such as the Food Stamp Program.

Federal surveys have confirmed the existence of Americans experiencing food insufficiency, but detailed information on the extent and severity had been limited until 1997.[8–13] An opportunity to expand the availability of national data was realized in the late 1980s with the inclusion of food insufficiency questions in the third National Health and Nutrition Examination Survey (NHANES III).[13] Because of its nationally representative sample design and the broad range of characteristics measured, NHANES III is an important source of data with which to investigate food insufficiency in the United States. In this analysis we used NHANES III interview data to estimate the prevalence of food insufficiency in the United States and to examine sociodemographic characteristics related to food insufficiency problems from 1988 through 1994.

Analysis of NHANES III data is one component of an ongoing federal and nonfederal effort to document the extent of hunger-related problems in the United States and to determine the consequences of such problems for individuals and families. In 1994, the US Department of Agriculture's Food and Consumer Service and the National Center for Health Statistics sponsored a conference on food security measurement and research.[15] Since then, federal, state, university, and advocacy researchers have worked together to develop a comprehensive survey measurement instrument from existing surveys such as NHANES III and to further study the phenomena of food insufficiency, food insecurity, and hunger.[13] Such collaboration will facilitate work toward continued monitoring and characterization of the complex nature of food insufficiency problems in the United States. Data on the difficulty some Americans experience in getting enough food to eat are critical to nutrition program planning and policy-making, especially during periods of welfare reform.

Methods

NHANES III, conducted in 2 phases between 1988 and 1994, was a cross-sectional representative sample of the US civilian noninstitutionalized population aged 2 months and older living in households, that is, persons who were not homeless. Mexican Americans, Black Americans, children younger than 5 years, and persons 60 years of age and older were oversampled to pro-

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vide more reliable estimates. Detailed descriptions of the sample design and operation of the survey have been published elsewhere.[16,17]

NHANES III consisted of 2 components: (1) a household interview administered in the home, which included a family questionnaire, and (2) an interview and examination conducted in a mobile examination center. Standardized protocols were used for all interviews and examinations.[16]

Sociodemographic Variables

During the family interview, a responsible adult provided information about each member of the family and about family characteristics such as family income, health insurance coverage, and employment status and education of the "family head." The family head was the person who owned or rented the home where the person selected for the survey lived. The respondent to the family questionnaire was not necessarily the family head.

Total family income for the previous 12 months was collected and assigned to a category. Categories ranged from "less than $1000" to "$80 000 and over." Categories were in $1000 increments below $19 999, in $5000 increments between $20 000 and $49 999, and in $10 000 increments between $50 000 and $79 999. The midpoint of reported family income category and family size, according to federal poverty guidelines,[18] was used to determine the poverty index ratio (PIR), the ratio of family income to the federal poverty line times 100. For this analysis, we created income categories using PIR cutoffs based on federal assistance program eligibility criteria: low income (PIR less than or equal to 130% of the poverty line; income below approximately $20 000 for a family of four); low middle income (PIR 131% to 185% of the poverty line; income of $20 000 to $28 000 for a family of four); middle income (PIR 186% to 350% of the poverty line; income of $28 000 to $53 000 for a family of four); and high income (PIR greater than 350% of the poverty line; income of more than $53 000 for a family of four).

Six family types were defined by determining the sex and marital status of the family head and whether there were children under 17 years of age living in the home. Single male– and single female–headed families were headed by an unmarried person 17 years of age or older. The family head was classified as employed if he or she had worked at any job or business in the past 2 weeks. Persons were classified as Food Stamp Program participants if the respondent to the family questionnaire reported receiving food stamps in the past month.

Self-reported race and ethnicity information was used to classify persons as non-Hispanic White, non-Hispanic Black, Mexican American, or "other." Age was determined at the time of the household interview. A person was defined as insured if he or she was covered by private health insurance, military health care insurance, Medicare, or Medicaid, and if the coverage paid for "more than accidents." Region of the United States was defined as 1 of the 4 US Census regions.[16]

Food Insufficiency

The NHANES III food sufficiency questions were designed to measure food insufficiency, defined as "an inadequate amount of food intake due to lack of resources."[14] Questions were asked as part of the family questionnaire administered in the home. Answers provided by the respondent to the family questionnaire were attributed to each individual in the survey who lived in that family. Therefore, population estimates of food insufficiency for individuals are based on the reported adequacy of the family's food resources.

A survey participant was classified as "food insufficient" if the respondent to the family questionnaire reported that the family "sometimes" or "often" did not get enough food to eat. This family food insufficiency question has been demonstrated to have both external validity (positive responses have been demonstrated to be related to food expenditure and nutrient intake)[8,9] and face validity (survey respondents understood the question and could answer it easily).[14,15,19,20] In addition, since this question in its present or a modified form has been used in other national surveys,[8–13,15] NHANES III data can be compared with other national data. Respondents who reported sometimes or often not getting enough food to eat were asked additional questions (Table 1). Questions 4 and 5 were added in the second phase of the survey.

Statistical Methods

The NHANES III data were weighted to account for the unequal probabilities of selection resulting from the survey cluster design, oversampling of certain groups, and nonresponse. Statistical analysis was performed with SUDAAN,[21] a program that takes into account the sampling weights and the complex sample design when calculating variance estimates. Ranges for estimates are expressed as 95% confidence intervals.

Logistic regression analyses examined the relationships between food insufficiency and other factors. Our interest was in understanding the overall effects of selected sociodemographic characteristics, adjusting for PIR. Because the variables we included in the logistic regression analysis were family-level variables, the appropriate unit of analysis is the family rather than the individual. Therefore, 1 individual per family was selected (n = 15 000 for total population; n = 5285 for low-income population; n = 2235 for low-middle-income population); the weights used were the means of the weights of the individuals in the family.[22] All of the variables for which odds ratios are reported were included in the models.

So that we could compare Mexican-American families and non-Hispanic Black families with a group that included non-Hispanic White and "other" families, 97 families that contained survey participants of 2 or more races/ethnicities were excluded from the analysis. Single female–headed families with children were compared with all other types of families. Family size was not included as a separate explanatory variable because family size was used to determine PIR. If any survey participant in the family was not covered by health insurance, the family was classified as uninsured.

Results

Prevalence of Food Insufficiency

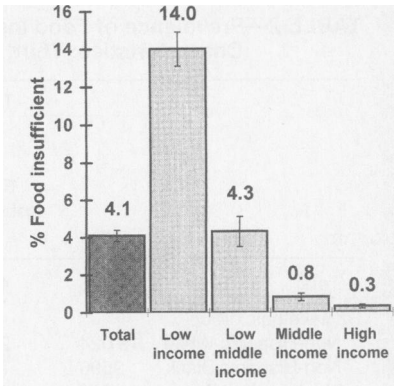
Table 1 shows the overall prevalence estimates derived from the family food sufficiency questions. According to the NHANES III data, between 1988 and 1994, 4.1% of the population—approximately 9 to 12 million Americans—lived in families that reported sometimes or often not getting enough food to eat. About 68.6% of these individuals lived in families that reported 1 or more days with no food or money to buy food in the previous month; 4.0% reported more than 14 such days. Nearly all of these families (98.6%) reported that the reason for their food insufficiency was a lack of money, food stamps, or vouchers from the Special Supplemental Food Program for Women, Infants and Children (WIC). In 2.7% of the families surveyed, children younger than age 17 had cut the size of or skipped meals in the previous month because of a lack of money.

Figure 1 shows the prevalence of food insufficiency by income category. The

TABLE 1—Prevalence of Food Insufficiency in the United States, as Measured by Questions on the Third National Health and Nutrition Examination Survey, 1988 through 1994

Family Food Insufficiency Question	%	SE
1. Describe food eaten by family (n = 33 856)		
a. Enough food to eat	96.0	0.3
b. Sometimes not enough to eat	3.6	0.2
c. Often not enough to eat	0.5	0.1
Food insufficiency ("sometimes" + "often") (If answer was "enough," respondent skipped to question 4)	4.1	0.3
2. No. days in previous month with no food or money to buy food (n = 2680)		
a. 0	31.4	2.9
b. 1–4	31.4	3.0
c. 5–9	21.1	2.2
d. 10–14	12.1	2.4
e. More than 14 (If answer was "0," respondent skipped to question 4)	4.0	0.8
3. Reasons for no food or money to buy food (n = 1918)		
a. Lack of transportation	8.5	1.8
b. No working appliances	1.6	0.5
c. Not enough money, food stamps, or WIC vouchers	98.6	0.4
d. Any other reason	2.2	0.6
4. Adults cut size of meals because of not enough money (n = 16 477)	6.5	0.4
5. Children cut size of or skipped meals because of not enough money (n = 10 792) (Answered only if there were children in the family younger than 17 years of age)	2.7	0.4

Note. Questions 1, 2, and 3 were administered from 1988 through 1994; questions 4 and 5 were administered from 1991 through 1994.



Note. Income categories are based on the poverty index ratio (PIR; the ratio of family income to the federal poverty line times 100). Low income = PIR less than or equal to 130% of the poverty line; low middle income = PIR 131% to 185% of the poverty line; middle income = PIR 186% to 350% of the poverty line; high income = PIR greater than 350% of the poverty line.

FIGURE 1—Prevalence of food insufficiency in the United States, by income category: third National Health and Nutrition Examination Survey, 1988 through 1994.

prevalence of food insufficiency was higher in the low-income group than in the low-middle-income group (14.0% vs 4.3%); however, food insufficiency existed even in the middle-income and high-income groups. Overall, 10.6% (SE = 0.7) of individuals living at or below 185% of the poverty line lived in families reporting sometimes or often not getting enough food to eat.

Table 2 shows the prevalence of food insufficiency by income category and racial/ethnic group, age group, and region of the United States. The overall prevalence of food insufficiency was highest among Mexican Americans (15.2%), next highest among non-Hispanic Black Americans (7.7%), and lowest among non-Hispanic White Americans (2.5%). Almost a quarter (24.8%) of low-income Mexican Americans, 13.5% of low-income non-Hispanic Black Americans, and 11.8% of low-income non-Hispanic White Americans lived in families reporting food insufficiency. Preferred language can be used as one measure of acculturation among Mexican Americans. An analysis of the language used to conduct the family questionnaire revealed that the prevalence of food insufficiency was significantly higher among Mexican Americans whose family respondent was interviewed in Spanish (21.2%; SE = 1.9) rather than English (9.7%; SE = 1.0).

Approximately 6.8% of children aged 2 months through 5 years lived in families reporting food insufficiency, in contrast to 1.7% of Americans aged 60 years and older (Table 2). In the low-income group, the prevalence of food insufficiency for children and adults 20 through 49 years of age ranged from 15.0% to 16.6%, while 5.9% of low-income adults aged 60 years and older lived in a family reporting food insufficiency. Food insufficiency did not differ significantly by region of the country.

Sociodemographic Characteristics of Food-Insufficient vs Food-Sufficient Individuals

Sociodemographic characteristics of Americans by food insufficiency status and income are shown in Table 3. In the total population, the majority of both food-insufficient (41.1%) and food-sufficient individuals (44.2%) lived in married-couple families with children. A larger percentage of food-insufficient individuals (31.5%) than food-sufficient individuals (9.0%) lived in families headed by a single female with children. This difference held in the low-middle-income group but not in the low-income group. In general, there were small differences in family type between food-insufficient and food-sufficient individuals in the low-income group. Food-insufficient individuals lived in larger families than food-sufficient individuals both in the overall population (mean 4.3 vs 3.4 family members) and in the low-income population (4.7 vs 4.0 family members).

An important finding is that 53.5% of food-insufficient individuals lived in families where the family head was employed, although this was a smaller percentage than that for food-sufficient individuals (75.1%). Family heads of food-insufficient familes were less likely than food-sufficient family heads to be high school graduates (42.7% vs 75.7%). Differences in family head employment and education were smaller in the low-income and low-middle-income groups. In the low-income population, a larger proportion of food-insufficient individuals (52.6%) than food-sufficient individuals (36.6%) participated in the Food Stamp Program. In the total population, a smaller percentage of food-insufficient

TABLE 2—Prevalence of Food Insuffiency in the United States, by Income Category and Selected Sociodemographic Characteristics: Third National Health and Nutrition Examination Survey, 1988 through 1994

	Total Population[a]				Low-Income Population[b]				Low-Middle-Income Population[c]			
	n	Food Insufficient, %	SE	Estimated Food-Insufficient Population, in Thousands	n	Food Insufficient, %	SE	Estimated Food Insufficient Population, in Thousands	n	Food Insufficient, %	SE	Estimated Food-Insufficient Population, in Thousands
Total[d]	33 856	4.1	0.3	10 202	12 072	14.0	0.9	7314	4447	4.3	0.8	1217
Racial/ethnic group												
Non-Hispanic White	13 024	2.5	0.3	4541	2245	11.8	1.4	3049	1673	4.0	1.2	779
Non-Hispanic Black	9598	7.7	0.8	2374	4372	13.5	1.3	1697	1295	6.9	1.4	296
Mexican American	9706	15.2	1.2	2367	4831	24.8	2.1	1832	1265	6.8	1.5	141
Age group												
2 mo–5 y	8230	6.8	0.5	1549	3576	16.5	1.3	1247	1066	3.4	0.8	94
6–11 y	3458	5.7	0.7	1270	1567	15.0	2.0	1005	442	4.9	2.4	146
12–16 y	2209	5.8	0.9	1036	935	16.0	2.9	770	285	6.6	1.9	156
17–29 y	4988	5.4	0.4	2695	1872	15.7	1.5	1861	730	4.4	1.2	303
30–39 y	3585	3.6	0.4	1518	1094	15.6	2.1	1098	433	6.7	1.9	258
40–49 y	2788	2.9	0.5	945	699	16.6	3.0	652	301	3.3	1.6	82
50–59 y	2040	2.3	0.5	513	435	8.0	1.6	232	197	7.3	3.8	106
60+ y	6558	1.7	0.2	675	1894	5.9	0.8	449	993	1.3	0.5	72
Region												
Northeast	4608	3.6	0.5	1817	1336	15.5	2.0	1463	576	2.0	1.2	117
Midwest	6402	3.5	0.5	2061	1840	13.3	1.5	1424	849	3.8	2.2	260
South	14 336	3.9	0.4	3313	5696	10.6	1.2	2206	1926	5.0	1.2	533
West	8510	5.6	0.8	3011	3200	19.6	3.0	2221	1096	6.1	1.9	307

[a] Includes data for income categories not shown separately.
[b] Low income = poverty index ratio (PIR; the ratio of family income to the federal poverty line times 100) less than or equal to 130% of the poverty line.
[c] Low middle income = PIR 131% to 185% of the poverty line.
[d] Includes data for "other" racial/ethnic group, not shown separately.

Americans (50.9%) than food-sufficient individuals (83.9%) were covered by health insurance.

Logistic Regression Analysis

Many of the sociodemographic characteristics shown in Tables 2 and 3 are related to PIR; logistic regression analyses were performed to determine whether the relationships between food insufficiency and the sociodemographic characteristics found in Tables 2 and 3 were independent of the effect of PIR and the other sociodemographic characteristics of families. Results of the first model, run on the total sample of NHANES III families, are shown in Table 4. PIR was found to be significantly related to food insufficiency status. A decrease in PIR by 100% increased the odds of a family's being food insufficient by 2.4 (1/0.41) times; for example, families whose income was at the poverty line were 2.4 times more likely to be food insufficient than families whose income placed them at 2 times the poverty line.

To further investigate the relationships between food insufficiency and other characteristics in families, regression models were created for the low-income (less than 130% of poverty) and low-middle-income (131% to 185% of poverty) categories. PIR was retained in these models because, within the low-income and low-middle-income populations, mean PIR was lower in the food-insufficient group than in the food-sufficient group. In the low-income group, mean PIR was 64% (SE = 2) of the poverty line in the food-insufficient group vs 79% (SE = 1) of the poverty line in the food-sufficient group. In the low-middle-income group, mean PIR was 147% (SE = 2) and 157% (SE = 1) of the poverty line in the food-insufficient and food-sufficient groups, respectively.

When PIR and the other sociodemographic variables were controlled, Mexican-American families were twice as likely as non-Hispanic White families to report food insufficiency in both the total and the low-income populations. After adjustment for PIR and other sociodemographic variables, there were no significant differences between non-Hispanic Black families and non-Hispanic White families in the total, low-, or low-middle-income categories.

With PIR and other sociodemographic variables controlled, low-middle-income single female–headed families with children were 5.5 times more likely than other family types to be food insufficient. There was no significant difference in food insufficiency between family types in the low-income population.

Among the characteristics of family heads investigated, only not completing high school was significantly related to food insufficiency status in the total and low-income populations (odds ratios = 1.5–1.6). With PIR and other sociodemographic variables controlled, employment status of the family head was not significantly associated with food insufficiency.

In the low-income population, families who chose to participate in the Food Stamp Program were 2.0 times more likely than nonparticipating families to report food insufficiency. In the low-income population, families not covered by health insurance were almost twice as likely as insured families to experience food insufficiency.

Discussion

It is important to place the concept of food insufficiency as measured by NHANES III in the context of current definitions of food insecurity and hunger. In the past decade, much work has been devoted to

TABLE 3—Characteristics of Food–Insufficient vs Food–Sufficient Individuals in the United States, by Income: Third National Health and Nutrition Examination Survey, 1988 through 1994

	Food Insufficient (n = 2732)		Food Sufficient (n = 31 124)	
	Estimate	SE	Estimate	SE
Total population[a]				
Family type, %				
Married couple living with child(ren)	41.1	3.6	44.2	0.9
Married couple, no child(ren)	9.1	1.8	26.6	0.7
Single male head living with child(ren)	1.4	0.5	1.7	0.3
Single male head, no child(ren)	9.4	1.5	7.8	0.4
Single female head living with child(ren)	31.5	3.3	9.0	0.4
Single female head, no child(ren)	7.5	1.2	10.7	0.4
Family size, mean	4.3	0.2	3.4	0.0
Family head employed, %	53.5	2.5	75.1	0.7
Family head high school graduate, %	42.7	2.8	75.7	0.9
Food Stamp Program participation in past month, %	44.4	3.1	9.0	0.7
Covered by health insurance, %	50.9	3.8	83.9	0.8
Low-income population[b]				
Family type, %				
Married couple living with child(ren)	46.6	4.6	39.3	1.7
Married couple, no child(ren)	8.5	2.1	11.2	0.9
Single male head living with child(ren)	1.7	0.6	2.2	0.5
Single male head, no child(ren)	5.5	1.2	7.0	0.8
Single female head living with child(ren)	32.2	3.7	26.3	1.4
Single female head, no child(ren)	5.4	1.1	14.0	0.8
Family size, mean	4.7	0.2	4.0	0.1
Family head employed, %	49.9	3.0	50.9	2.0
Family head high school graduate, %	37.5	2.5	51.8	1.5
Food Stamp Program participation in past month, %	52.6	3.7	36.6	2.3
Covered by health insurance, %	48.1	4.5	62.4	2.4
Low-middle-income population[c]				
Family type, %				
Married couple living with child(ren)	20.7	5.5	47.2	2.3
Married couple, no child(ren)	8.0	4.8	16.9	1.4
Single male head living with child(ren)	0.0	0.0	2.6	0.8
Single male head, no child(ren)	14.0	5.7	10.1	1.2
Single female head living with child(ren)	47.4	11.4	10.8	1.2
Single female head, no child(ren)	9.9	4.8	12.4	1.0
Family size, mean	3.2	0.3	3.6	0.1
Family head employed, %	71.8	8.4	72.7	1.7
Family head high school graduate, %	62.7	9.3	66.7	1.8
Covered by health insurance, %	59.3	7.9	76.6	1.6

[a] Includes data for income categories not shown separately.
[b] Low income = poverty index ratio (PIR; the ratio of family income to the federal poverty line times 100) less than or equal to 130% of the poverty line.
[c] Low middle income = PIR 131% to 185% of the poverty line.

defining and measuring hunger and food insecurity in the United States, and a conceptual model has emerged.[15,23–27] According to the commonly accepted Life Sciences Research Office definition, food insecurity exists "whenever the availability of nutritionally adequate, safe foods, or the ability to acquire personally acceptable foods in socially acceptable ways is limited or uncertain."[23] Food insecurity can exist at the family or household level, is multidimensional, and includes problems with quantity or quality of food, uncertainty about the supply of food, and the feelings one has about one's situation.[25,28,29] Hunger is defined as "the uneasy or painful sensation caused by a lack of food"[23]; it exists at the level of individual family members within families experiencing food insecurity.

The NHANES III family food insufficiency questions measured self-reporting of the *quantity* component of food insecurity at the family level and did not attempt to measure the quality, uncertainty, or psychological components of food insecurity. For this reason, NHANES III estimates of food insufficiency do not approximate the total extent of food insecurity in the United States.[13,14,20,23,30] Instead, food insufficiency is closer (but not equivalent) to the concept of hunger.

The NHANES III estimates can be compared with those of another federal study conducted from 1989 to 1991. Using a similar food insufficiency question at the household level, the US Department of Agriculture's Continuing Survey of Food Intakes by Individuals (CSFII) found that about 9% of low-income (PIR less than 131% of the poverty line) Americans reported that they sometimes or often did not get enough food to eat.[12] The difference in low-income prevalence estimates between NHANES III (14.0%) and CSFII (9.0%) is possibly due to differences in survey design, administration, and question construction.[15] In addition to the 3 responses offered by the NHANES III question, the US Department of Agriculture question offered a fourth response—"Enough, but not the kinds of food we want to eat."[12]

This analysis shows that the food insufficiency problem in the United States was most prevalent among children and younger adults. At any one time between 1988 and 1994, approximately 2.4 to 3.2 million children younger than age 12 lived in food-insufficient families. An additional 0.7 to 1.3 million teenagers (12 to 16 years of age) lived in food-insufficient families. The adverse consequences of food insufficiency illustrate why these national findings are reason for concern. An analysis of 1985/86 CSFII data showed that low-income women with children reporting food insufficiency had lower mean food and nutrient intakes than women with children in food-sufficient families.[9] Insufficient food has been associated with impaired growth and cognitive development in children.[31–33]

NHANES III estimates of food insufficiency for children and older Americans (aged 60 years and older) are lower than those found in 2 special studies of hunger and food insecurity. The Community Childhood Hunger Identification Project's (CCHIP) Survey of Childhood Hunger in the United States estimated that from 1992 to 1994, 4 million low-income children (PIR less than 185% of the poverty line) younger than age 12 were hungry.[4] An additional 9.6 million children were reported to be at risk of hunger (food insecure). An Urban Institute study conducted in 1993 reported that 2.5 million adults aged 60 years and older were food insecure.[5]

Dissimilarities between estimates from the CCHIP and Urban Institute studies and NHANES III are likely to be caused by the different conceptual frameworks and ques-

TABLE 4—Relationship of Food Insufficiency to Selected Sociodemographic Characteristics of US Families: Results from the Logistic Regression Analysis on Data from the Third National Health and Nutrition Examination Survey, 1988 through 1994

	Total Population[a]		Low-Income Population[b]		Low-Middle-Income Population[c]	
	OR	95% CI	OR	95% CI	OR	95% CI
Poverty index ratio	0.41	0.34, 0.49	0.46	0.31, 0.66	0.01	0, 0.1
Race/ethnicity						
Mexican American	2.0	1.4, 2.8	1.9	1.3, 2.7	1.3	0.6, 3.1
Non-Hispanic Black	1.3	1.0, 1.8	1.1	0.8, 1.6	1.3	0.5, 3.1
Non-Hispanic White/all other	1.0		1.0		1.0	
Region						
Northeast	1.0	0.5, 1.7	1.0	0.6, 1.7	0.5	0.1, 2.8
Midwest	1.0	0.6, 1.6	0.9	0.6, 1.4	0.5	0.1, 1.5
South	0.7	0.5, 1.2	0.6	0.4, 0.9	0.8	0.3, 2.2
West	1.0		1.0		1.0	
Family type						
Single female head with children	1.9	1.4, 2.5	1.2	0.9, 1.8	5.5	2.0, 15.4
All other	1.0		1.0		1.0	
Education of family head						
Not high school graduate	1.5	1.1, 2	1.6	1.2, 2.1	1.2	0.5, 2.7
High school graduate	1.0		1.0		1.0	
Employment status of family head						
Unemployed	1.0	0.8, 1.3	0.8	0.6, 1.0	1.5	0.6, 3.7
Employed	1.0		1.0		1.0	
Food Stamp Program						
Participant			2.0	1.4, 2.8		
Nonparticipant			1.0			
Health Insurance						
Uninsured	1.9	1.4, 2.6	1.7	1.2, 2.4	2.0	0.8, 4.7
Insured	1.0		1.0		1.0	

Note. For each model, odds ratios (ORs) are adjusted for all other variables for which odds ratios are reported. CI = confidence interval.
[a] Includes data for income categories not shown separately.
[b] Low income = poverty index ratio (PIR; the ratio of family income to the federal poverty line times 100) less than or equal to 130% of the poverty line.
[c] Low middle income = PIR 131% to 185% of the poverty line.

tions used to measure food insecurity and hunger vs food insufficiency. Also, the surveys used different sampling methodologies. The NHANES III sample was a national prevalence sample, while both the CCHIP and Urban Institute studies extrapolated from community data to achieve national estimates. In addition, measuring hunger and food insecurity in the elderly has been found to be different from measuring these conditions in younger adults and children. In a naturalistic inquiry on hunger in the elderly, Olson et al. found that the elderly may be more reluctant to state that they do not have enough to eat.[34,35] For this reason, NHANES III data may have underestimated the percentage of adults aged 60 years and older who experienced food insufficiency.

In the United States, non-Hispanic Blacks and Mexican Americans are poorer than non-Hispanic Whites; the higher prevalence of food insufficiency found in these groups can be at least partly attributed to a lower mean PIR. However, when PIR and other sociodemographic characteristics were controlled, overall and in the low-income population, Mexican-American families were still twice as likely as non-Hispanic White families to be food insufficient, and the prevalence was even higher among primarily Spanish-speaking Mexican Americans. It is possible that some of these differences in reported food insufficiency were due to differences between Mexican Americans' and other groups' interpretation of "enough food to eat."

Families with children headed by single females are often highlighted in discussions of poverty. With PIR and other sociodemographic variables controlled, families headed by single females with children were more likely than others to be food insufficient in the total and low-middle-income populations, but not in the low-income population. One explanation for this may be that at the lowest income level, different family types experience extreme hardship equally (i.e., lack of money or food stamps), whereas in the low-middle-income families that are not eligible for the Food Stamp Program, the struggle to balance a job and child care is most pronounced for single female–headed families. Notably, for 96.3% (SE = 2.5) of the low-middle-income food-insufficient individuals who lived in families headed by single females, the family head was employed.

Indeed, food insufficiency is not limited to the unemployed. Some Americans' work income is not enough to enable them to feed their families enough food, especially if they lack health insurance. Persons without health insurance pay more for health care than insured persons.[36] Low-income uninsured individuals may find themselves in the precarious situation of having to choose between paying medical bills and paying for food.

In the low-income group, choosing to participate in the Food Stamp Program was associated with an increase in food insufficiency. This counterintuitive finding, that persons receiving government assistance report more food insufficiency than persons

who do not receive government assistance, has been found in other studies.[12,37] Self-selection is the probable cause. Often, families apply for food stamps only after experiencing significant material hardship; at the same income level, persons who receive assistance are likely to be more in need of food than those who do not. In addition, food stamps often run out before the end of the month.[38]

The results of the logistic regression models should be interpreted cautiously with regard to understanding the determinants of food insufficiency. Some sociodemographic variables that may be related to food insufficiency were not included because they were not available in the NHANES III data set. For example, employment and education status of every adult in the family, the family's access to supermarkets, and household expenses, including food expenditures, were not collected in NHANES III. In addition, although nationally representative, NHANES III primarily sampled urban regions of the United States and an urban–rural comparison was not possible.

In conclusion, the NHANES III data demonstrate that food insufficiency is a considerable problem in the United States and is not limited to very low-income persons, specific racial/ethnic groups, certain family types, or the unemployed. Welfare reform is currently changing policies that determine how and to what extent the federal and state governments aid struggling families, individuals, and children. Accurate characterization of the magnitude and nature of problems some Americans face in getting enough food to eat is essential for the planning and evaluation of programs and interventions that affect the food security of our communities. □

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